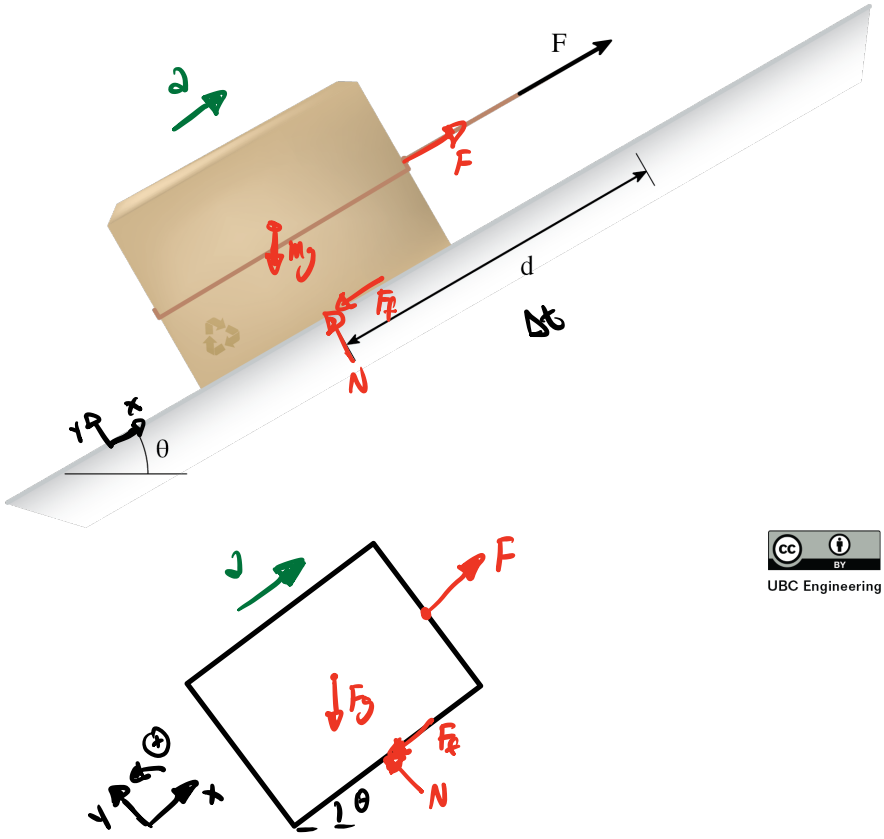
You ask your little cousin to move a 1 kg box up a hill with a coefficient of kinetic friction $\mu_k = 0.2$. Rather than carrying the box, he overthinks things and drags the box up the hill with a rope. Determine the average power exerted by your little cousin if he applies a force $F = 10\ N$ and he drags the box up the hill $d = 3\ m$ with an incline of $\theta = 30\ degrees$.



$\Sigma F_x = m a_{Gx} \Rightarrow F - F_f - F_g \sin\theta = m a \quad (1)$

$\Sigma F_y = 0 \Rightarrow N - F_g \cos\theta = 0$

$\therefore N = F_g \cos\theta = mg\cos\theta$

$= (1\,kg)(9.81\,m/s^2)\cos 30^\circ$

$N = 8.496\ N$

$F_f = \mu_k N$

(1) $\Rightarrow$ $F - \mu_K N - mg\sin\theta = ma$

$$a = \frac{F - \mu_K N - mg\sin\theta}{m} = \frac{10N - (0.2)(8.496N) - (1kg)(9.8\,m/s^2)\sin 30^\circ}{(1kg)}$$

$$a = 3.396\ m/s^2$$

$$\Delta s = \cancel{v_0^{0}}\,t + \frac{1}{2}at^2 \Rightarrow 3m = 0 + \frac{1}{2}(3.396\ m/s^2)\,t^2$$

$$\therefore t = 1.329\ sec$$

$$\Delta v = \frac{\Delta s}{\Delta t} = \frac{3m}{1.329sec} = 2.257\ m/s$$

$$P = FV \Rightarrow \Delta P = F\Delta v = (10N)(2.257\ m/s) = 22.57W$$

$$\boxed{P = 22.57W}$$

Alternatively: $P = \frac{W}{\Delta t}$ $\qquad W = Fd = (10N)(3m) = 30J$

$$P = \frac{30J}{1.329sec} = \underline{22.57W} \text{ (matches!)}$$